can be achieved. Unfortunately, there is no such ideal channel in practice. Besides, it is quite difficult to maintain strict synchronization. That is why it is important to employ a good multiple access technique. As for a CDMA technique, well designed multiple access codes are the root of the system.

It is known that the wireless channel is a typical random time-varying channel, in which there exists not only random frequency dispersion (Doppler frequency shift) but also random time dispersion (multi-path propagation). The former introduces time selective fading to the received signals, i.e., the received signal's frequency varies randomly with time. The latter introduces frequency selective fading to the received signals, i.e. different frequency spectrum components of the received signal vary differently with time. The fading deteriorates the system's performance seriously and at the same time, reduces the system's capacity. This is especially true for the channel's time dispersion, which is caused by multi-path propagation: it prevents signals from arriving simultaneously, so ISI and MAI are caused and the system's capacity is drastically reduced. When the relative time delay between signals is zero, it is quite easy to achieve orthogonality between signals, indeed any orthogonal codes can meet that requirement, but when the relative delay between signals is non-zero, it becomes very difficult to

do so. In fact, it has been proven that there are no such spread spectrum multiple access codes in binary, finite and even complex number spaces. In particular, MAI and ISI contradict one another so that smaller MAI leads to larger ISI and vice versa.

Therefore, the distinction between different CDMA systems lies mainly in the selected multiple access codes, i.e. in a good system, ISI and MAI must both be small, otherwise they must be larger.

Existing CDMA systems have either very low efficiency or have very short communications distance for example about several hundred meters or do nothing to MAI and ISI and then all that can be done is to alleviate them by using relatively good multiple access codes.

Summary of the Invention

The aim of the invention is to present a new, simpler, clearer and faster design scheme of spread spectrum multiple access codes. Based on the scheme, both MAI and ISI in the corresponding CDMA system can be controlled and thus a digital wireless communications system with large capacity can be constructed.

Ideal spread spectrum multiple access codes should satisfy the two main conditions below:

First, each code's auto-correlation function should be an ideal impulse function, i.e. the function should be zero everywhere except at the origin. From the view of

orthogonality, each code should be orthogonal to its own relative time delay version unless the relative time delay is zero;

Second, the cross-correlation function between any two codes should be zero everywhere. From the view of orthogonality, each code should be orthogonal to all the other codes with any relative time delay (including the zero delay).

To elaborate, we denote the auto-correlation values at the origin as the main-lobe value, while the auto-correlation values not at the origin, as well as the cross-correlation values are denoted as side-lobe values. For an ideal CDMA system, the side-lobe values of all the auto-correlations and cross-correlations should be zero. For a practical system, however, it is impossible to satisfy that condition. In this case, all that can be done is to try to make the values of the side-lobes as small as possible (or the main-lobe to side-lobe value ratio as large as possible) and the number of the side-lobes as few as possible. As for binary codes, the smallest non-zero side-lobe's value must be +1 or -1.

Therefore, in some embodiments of the present invention a spread spectrum multiple access coding scheme controls and reduces the side-lobes' values of the auto-correlations and cross-correlations.